MOBILE STATION AND ELASTOMERIC COVER

FIELD OF THE INVENTION

The invention relates to a keypad, and more particularly to a keypad that provides structural integrity to a mobile station, as well as provide enclosure walls that resist moisture ingress.

BACKGROUND OF THE INVENTION

Use of mobile stations, including mobile phones by the public has grown to increased levels. The mobile phone is used in an increasing variety of circumstances and settings. The quantity of monthly minutes per user is increasing, particularly amongst experienced mobile phone owners. Attendant with such heavy use, is a growing frequency of dropping a mobile phone or exposing the mobile phone to liquids and other harmful environments.

Conventional mobile phones may be susceptible to liquid ingress into the phone wherever an opening appears in a mobile phone enclosure. The fewer openings that exist in the exterior of a mobile station, the better will be the resistance to liquid ingress.

Costs of building a mobile station tend to have a positive correlation to the number of discreet parts that need to be assembled. Where it is possible to form multiple parts out of a common material, costs can be reduced significantly. This is why it is often the case that mobile phone keypads are formed out of a single piece of rubber or elastomer.

There has been a growing trend to make mobile stations amenable to customization to suit the tastes of the owner of the mobile station. This is can be seen, for example, in the common use of interchangeable rigid faceplates to the Nokia ® 5100 series mobile phones. Designs of figures and patterns on such covers, however, must work around the button grid located at the bottom front of the phone cover, i.e. the generally monochromatic buttons tend to distract from such cover art.

SUMMARY OF THE INVENTION

One or more embodiments of the invention may provide a partly translucent flexible cover to a mobile station. Such a cover provides a circuit-board-enclosing shell, while providing the upper surface part of electromechanical buttons used to operate the mobile station. Such an arrangement provides fewer openings for water ingress as compared to many prior art, rubber-keypad-hard-cover combinations. Such an embodiment provides for elastomeric tension that wraps to a backside of a mobile station to keep the cover both attached and properly oriented in relation to the

mobile station.

An embodiment may also provide an intermediate layer to a mobile station, wherein the intermediate layer is a monolithic part having movable key-tops and a shatter-resistant lens for, among other things, protecting a display of a mobile station. Such an embodiment supports the key-tops on extensions of semi-flexible material formed as one monolithic part.

The embodiment minimizes part count, doing many of the functions of a lens, gasket, cover and keypad of mobile station covers and supports of the prior art. The intermediate layer may operate connected to a mobile station without additional embodiments, or the intermediate layer may operate connected to a mobile station with a translucent flexible cover embodiment.

The foregoing embodiments, or parts thereof, when combined (particularly with a dome switch) make new embodiments by providing an electro-mechanical, actuating means or button structure with a superficial moisture barrier.

According to an embodiment of the invention, a flexible or elastomeric cover for a mobile station having a lens and buttons is disclosed. The embodiment has a translucent portion, at least one opposing surface and a perimeter grip having substantially the same perimeter as the lens.

According to another embodiment of the invention, a semi-rigid, front cover for a mobile station having a display and at least one key-dome switch is disclosed. The cover has a lens for protecting the display. The cover embodiment has at least one lever arm with a key-top mounted thereon. The key-top is situated to engage the key-dome switch to provide a switch-actuating means. The cover has a fastening means for attaching the cover to the mobile station.

According to still another embodiment of the invention, a button configuration for a mobile station is disclosed. The button configuration includes a key-dome switch and a key-top supported over the switch. An elastomeric sheet is placed over the key-top, which may provide some resistance to water ingress around the edges of the key-top.

At least one embodiment unifies the lens and elements of at least one button or key-top into a single piece. This simplifies manufacture of the mobile station, and keeps inventory in the manufacturing process to a smaller level. There is a potential to minimize assembly steps and improve reliability in final assembly.

An embodiment may provide a nearly planar surface that covers virtually all portions of a mobile station except a display. Such an arrangement may be more amenable to artistic expression, without compromising a need to denote button functionality with symbols printed thereon.

A mobile station equipped with an embodiment may be somewhat more resistant to sudden shocks because of the shock absorbing nature of elastomers.

Water may be more effectively repelled by an embodiment to the extent that openings around buttons no longer exist at the most outer layer of the mobile station when the embodiment is mated to the mobile station. In addition, some areas of what may be called a circumferential junction between front cover and back cover may be additionally shielded by an elastomeric embodiment of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The disclosed inventions will be described with reference to the accompanying drawings, which show sample embodiments of the invention, wherein:

Fig. 1 shows an exploded view of an embodiment of the invention with a mobile station;

Fig. 2a shows a detailed view of a front cover embodiment of the invention;

Fig. 2b shows a side view of the front cover embodiment of the invention;

Fig. 3 shows an elastomeric cover embodiment of the invention;

Fig. 4 shows a close-up view of the elastomeric cover embodiment of the invention;

Fig. 5a shows a cross-sectional view of a button of an embodiment of the invention;

Fig. 5b shows a cross-sectional view of a button according to another embodiment; and

Fig. 5c shows a cross-sectional view of a button according to yet another embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 1 shows an exploded view of one or more embodiments of the invention. Fig. 1 shows an embodiment of the invention, which provides a front cover **105** with integral button key-tops and lens. To aid in back-lighting of button surfaces, the cover **105** may be translucent in parts. Because components on an upper-circuit board may be fragile or susceptible to short circuiting, it is a common practice to enclose the upper-circuit board with a cover.

The cover alone may be insufficient to shelter and hold the battery **103**. Thus the addition of an elastomeric cover **107** and a back cover **109** may provide shelter, among other things. A back cover **109** may provide the completing piece to a predominantly rigid mobile station. The mobile station chassis may have key-dome switches placed on a printed circuit board. Other switches may be used as an alternative; however, any portion of the switch that closes a circuit because of a

moved position may be a type of button portion **112**. Additional layers above the button portion may modify such a mobile station chassis 101. Such additional layers may be embodiments and may provide additional surfaces and platforms that enhance tactile feedback of buttons, reduce forces needed to actuate buttons, or otherwise provide protection to buttons against insertion of foreign objects or water amongst button elements. One or more of such surfaces and platforms may be button portions.

The chief component that the foregoing front cover **105** may mate or fasten to is a mobile station comprised of a number of circuits that support, among other things, an antenna, a transceiver, sound input and output devices, and push-button sensors. A display **102** is provided so that feedback is available when entering phone numbers and other data to the mobile station. The chief supporting structure may be one or more printed circuit boards bonded or otherwise fastened together. Such an aggregation of circuit boards may be a mobile station chassis **101**, which may include one or more stiffening members. The construction of a mobile station may be modular, and may permit a battery **103** to be attached by two or more leads. Thus the front cover **105** may offer protection, and possibly additional rigidity to the mobile station chassis. The assembly of the front cover **105** to mobile station chassis **101** may be called a modified mobile station.

Fig. 2 shows a detailed view of a front cover **200** according to an embodiment. A lens **201** is snugly fitted superimposed over the display, wherein the lens has lateral dimensions similar to the display. The front cover may be made of a material selected to be stiff, yet sufficiently flexible for button-levers or lever arms that may be deflected by ordinary finger strength of a person. At least one button portion is located in a button zone **202** that is disposed in a second half of the front cover. A small area having a generally flat surface **204** may connect the button portion **202** to the lens **201**. Lever arms **203**, **205**, and **207** may provide a support for key-tops **213, 215 and 217** whereby the key-tops may be positioned above key-domes **223, 225, and 227** on a mobile station chassis or circuit board. The key-domes may be made of polyester, Mylar ™, or other materials as is known in the art. The positioning of the key-domes and lens in relation to the chassis may be accomplished by screw-holes **251**, snap fittings or other fastener means known in the art.

The front cover **200** may be tinted, painted, finished to be transparent, opaque or translucent; however, if backlit key symbols are desired, some areas close to the symbols may be made transparent to light. The lens **201** may have dimensions of length and width, which collectively establish a perimeter. The perimeter may be rectangular. Fig. 2b shows how a lens may be elevated from a surrounding surface

205 of the front cover. The cover has a side **250** that faces the mobile chassis. The lens **201** may be elevated from the surrounding surface **205** of the front cover wherein the upper surface of the lens forms a plateau above the surrounding surface, said plateau having walls **251** that may rise vertically from the surrounding surface. The walls need not be parallel; however, the walls may operate best if the walls form acute angles with the surrounding surface, i.e. an elastomeric cover may fit better around the walls in that situation.

Fig. 3 shows a detailed view of an elastomeric cover **300** embodiment of the invention, sometimes called a flexible cover. The elastomeric cover has first inner surface **301** and second inner surface **303** that partially enclose a volume, and so can be said to have inner surfaces and outer surfaces **311** and **313**. Because the elastomeric cover **300** must be resistant to accidental slippage or removal from the assembled mobile station, it is constructed with a first inner surface **301** and a second inner surface **303** which may have surface normals pointed in substantially opposite directions. Fig. 3 shows a first strap **351**, which may encircle a front cover. In addition there is a second strap **352** or top strap which may also encircle a front cover. The second strap **352** may still be called a strap, even if there is an absence of any gap or hole at the top of the elastomeric cover.

A rim is a specific form of a strap. A rim is sized to encircle a single monolithic part and may keep a surrounding elastomeric material strongly biased to a position snug against the single part.

Though the elastomeric cover may be flexible, it has a slight bias toward a shape that encloses a volume having dimensions of height, width and length that may be slightly smaller than the height, width and length of the combined front cover, mobile station chassis, and back cover assembly. Sliding the elastomeric cover **300** around such an assembly may provide a bias that holds the back cover in place against the combined chassis and front cover, thus holding the assembly together in a manner similar to the use of a rubber band.

Protruding parts of the mobile station and front cover may provide an orienting function in relation to the elastomeric cover. For example, the lens may extend from the front cover with substantially parallel supporting walls. A perimeter grip **321** or hole in the elastomeric cover may have dimensions substantially the same as, or smaller than the lateral dimensions of the lens. Placing the elastomeric cover around the lens may stabilize the elastomeric cover from shifting as the mobile station is handled and stored. Moreover, a tight seal may be accomplished. Note that the lens may have an irregular shape in that it need not be rectangular. The perimeter grip **321** is a type of rim.

A broad side of a strap may provide a surface that is contiguous with a surrounding surface of a rim. A surface is contiguous if it has a flat, or gently bending contour. Fig. 3 shows a broad side of strap **351** that is contiguous with the surrounding surface of the perimeter grip.

The lens may be made of a plastic or other material that is not brittle. Though the lens may provide the chief protection for any Liquid Crystal Display (LCD) of the mobile station, an embodiment may provide additional protection by providing no opening sized to fit around the lens. In other words, an embodiment may be sufficiently transparent that the embodiment may cover the lens without substantially degrading the visibility of the LCD. This embodiment may enhance water resistance perhaps at the expense of unblemished visibility of the LCD. If such an elastomeric cover is subject to degradation due to wear and tear, manufacturing costs may be sufficiently low to make the elastomeric cover disposable in a rapid replacement cycle.

Fig. 4 shows a close-up view of a surface of an elastomeric cover **400**. The surface may carry a mark **401** that may be transparent to light. Such a mark **401** may serve either functional or aesthetic purposes, i.e. the mark **401** may indicate a function that occurs when a button is depressed, or the mark **401** may provide a consistent color to the overall pattern of the cover, so that artwork is perceived as a whole on the cover. Functional marks may be placed near surfaces that are supported by a key-top **490**. The mark may be a translucent portion. On the other hand, good contrast to show a symbol may occur by inverting the light and dark sections such that the part or parts of the cover that are not the one or several marks is a translucent portion, while the marks may be opaque, or nearly so. Alternatively, any translucent arrangement that permits the entire cover to be translucent, but provides contrast between marks and surrounding areas, may satisfy the goal of permitting back-lighting of the marks.

Fig. 5a shows a cross-sectional view of a button according to an embodiment. A button may have indistinct outer edges, i.e. the button surface may blend with the surrounding flexible cover. The upper layer is an elastomeric cover **501**, which may be a sheet held in place by a combination of elastic tension and friction. Beneath the elastomeric cover is a key-top **503**, which may be part of a front cover. Key-top **503** may have a bias upward, toward the elastomeric cover **501**. Key-top may have a convex lower surface **505** that is suitable for collapsing a dome for a dome switch. Other switches may be actuated by lower surface **505** as is known in the art. A key-dome switch **507** may be disposed below the convex lower surface **505**. A printed wiring board **509** may provide an open circuit that may be closed when in contact

with the key-dome switch **507**.

Fig. 5b shows a cross-sectional view of a button according to another embodiment. The upper layer is an elastomeric cover **511**, which may be a sheet held in place by an elastic tension. Beneath the elastomeric cover **511** is a cover support **512,** which may provide a gap or hole that permits some vertical travel for the cover prior to touching any third object. A post **515** may be positioned near the hole by a finger **513,** which may extend between buttons. A key-dome switch **517** may be disposed below the post **515**. A printed wiring board **519** may provide an open circuit that may be closed when in contact with the key-dome switch **517**.

Fig. 5c shows a cross-sectional view of a button according to yet another embodiment. The upper layer is an elastomeric cover **521**. Beneath the elastomeric cover is a cover support **522**, which may provide a gap or hole that permits some vertical travel for the cover prior to touching any third object. A post **525** may extend partially into the hole. A key-dome switch **527** may be disposed below the post **525**. A printed wiring board **529** may provide an open circuit that may be closed when in contact with the key-dome switch **527**. Elastomeric cover **521** may have a tactile cue for each button, which may include a dimple, a ridge, or a elevated bump to provide tactile feedback to fingers searching for button centers. Such a tactile cue may be located above key-dome switch centers.

In each of the foregoing embodiments, the deformable, outer surface of a button presents visually indistinct boundaries with the rest of the elastomeric cover. Prior art buttons has elastomer extending through relatively rigid holes. This was generally accomplished by making the elastomeric tops of the prior art buttons with sharp transitions from button top to button support or wall.

Parts of the mobile station may be shielded from some shocks by embodiments of the invention. Such embodiments include the provision of elevated thickness to the elastomeric cover. Such a thickness would be the distance between an inner surface and an outer surface of the elastomeric cover. The increased thickness may be called a bumper. Bumpers may be located at the extremities of the cover, e.g. where the cover meets a rounded corner of the mobile station chassis. Fig. 3 shows a top extremity **323** and a bottom extremity **325**. Bumpers may be provided at extremity **323** and extremity **325.** Furthermore, one or more bumpers may be located near the perimeter grip such that the elastomeric material of the elastomeric cover extends above any supporting walls of the lens. This may have the effect of reducing scratching upon the occasional drop of the mobile station.

Although the invention has been described in the context of particular embodiments, various alternative embodiments are possible. For example, switches

other than key-dome switches may be used. Thus, while the invention has been particularly shown and described with respect to specific embodiments thereof, it will be understood by those skilled in the art that changes in form and configuration may be made therein without departing from the scope and spirit of the invention.